6-1 General

This chapter illustrates the application of the design criteria discussed in previous chapters. Four typical service schools, each having different area characteristics, have been selected to serve as illustrations:

A. A 30,000 sq. ft. school whose instruction space is entirely devoted to classrooms and labs (see Figure 6-1 below).

B. A 150,000 sq. ft. school whose ratio of classroom/lab space to shop space is 6:1 (see 6-2 below).

C. A 150,000 sq. ft. school whose ratio of classroom/lab space to shop space is 1:4 (see Figure 6-3 below).

D. A 400,000 sq. ft. school whose ratio of classroom/lab space to shop space is 1:1 (see Figure 6-4 below).

In addition, a plan depicting the expansion of a service school in three phases to an ultimate size of 400,000 sq. ft. is shown in Figure 6-5. This chapter does not prescribe definitive design solutions; rather it uses hypothetical models to demonstrate the ways in which the criteria contained in this manual may be applied.

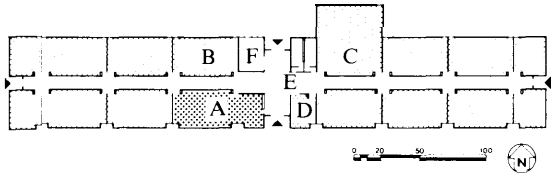
In paragraphs 6-2 through 6-5 each school is briefly described and its characteristic features noted. Paragraph 6-6 then discusses the ways in which these schools exemplify specific design criteria and principles. Utilities requirements for each school are furnished in paragraph 6-7.

6-2 Illustrative Design for 30,000 Sq. Ft. School

This small, classroom-oriented school utilizes single-story construction. It typifies either an addition to an existing facility or a single independent building. It contains ten 1500 sq. ft. classroom modules, a large 125-man classroom, and four instructor preparation spaces. The student lounge and the restrooms are centrally located, as is the administration area. The administration area occupies approximately 10% of the total functional space.

6-3 Illustrative Design for 150,000 Sq. Ft. School (Classroom/Shop Ratio, 6:1)

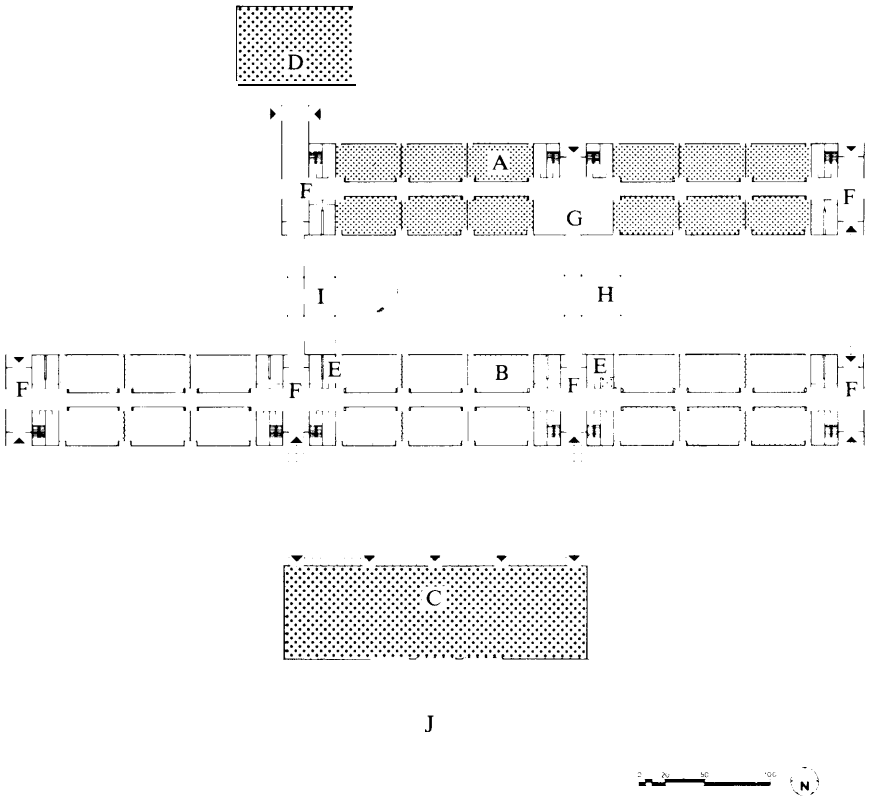
Because this school devotes a majority of its space to classroom functions, the facility is designed with a two-story classroom building. The administration and shop areas, which occupy less space, are in single-story structures. The school contains the full range of service school activity spaces: administrative areas, classrooms, shops, and a technical library. The library is located adjacent to those administrative elements which it most frequently serves. For ready access, support spaces such as the reception area, the student lounge, the snackbar, and restrooms are located at circulation nodes or along primary circulation routes.



A Administration
B Classroom/Labs
C Large Conference Classroom
D Instructor Preparation
E Restrooms
F Student Lounge

Description: Instruction area is totally Conference/Lab Space. Single-story Building.
Utilities: Refer to Section 6-7.

Figure 6-1
Illustrative Plan, 30,000 Sq. Ft. School.



A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron

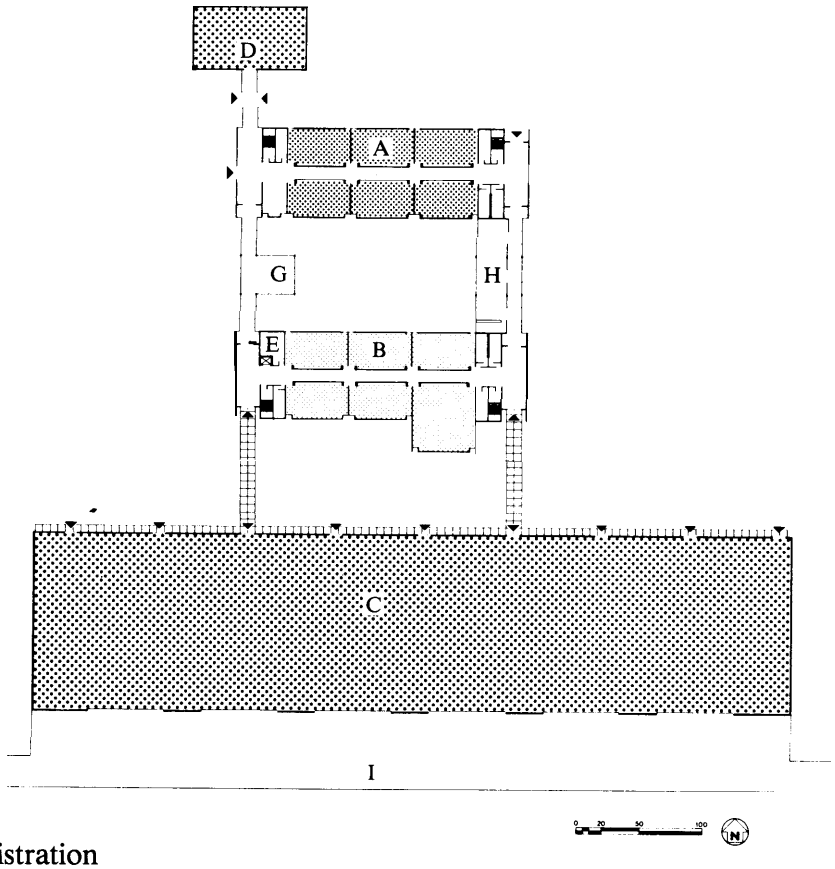
Description: Ratio of Classroom/Lab Space to Shop Space is 6:1. Administration — One- and Two-story Buildings. Classroom/Labs — Two Stories.

Utilities: Refer to Section 6-7.

Figure 6-2
Illustrative Plan, 150,000 Sq. Ft. School
(Primary Instruction Space; Classroom).

6-4 Illustrative Design for 150,000 Sq. Ft. School
(Classroom/Shop Ratio, 1:4)

The educational characteristic of this school is that most of the school's total space is devoted to shop instructional areas. Because of this and the fact that such schools typically require smaller administration areas, the administration and classroom buildings are single-story construction. The shop building is also single-story, but with high ceilings and the potential for mezzanine level support areas. The library is adjacent to the administration building, and the support spaces - lounge, snack bar, restrooms - are located along primary circulation routes. For utilities estimates see paragraph 6-7.



A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron

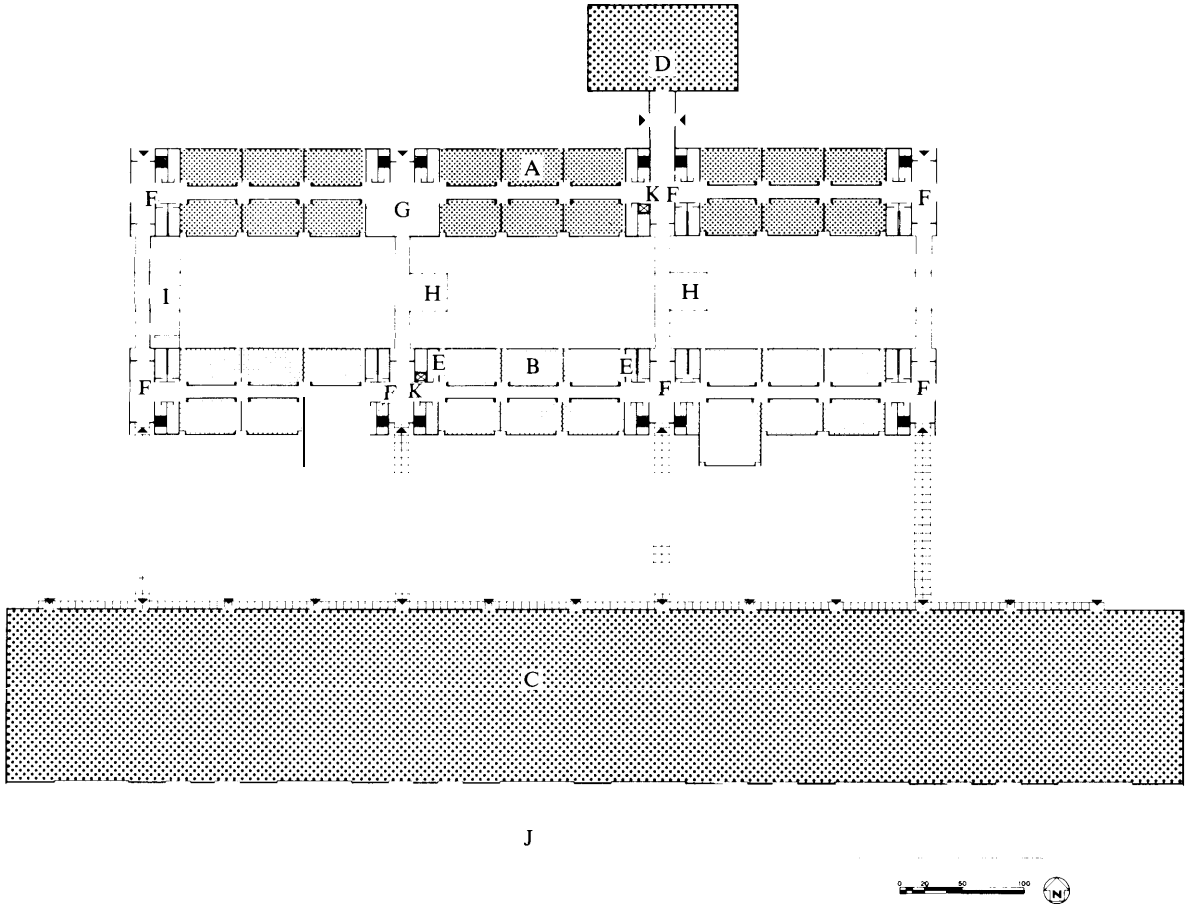
Description: Ratio of Classroom/Lab Space to Shop Space is 1:4. Administration — One Story. Classroom/Labs — One Story.

Utilities: Refer to Section 6-7.

Figure 6-3
Illustrative Plan, 150,000 Sq. Ft. School
(Primary Instruction Space; Shop).

6-5 Illustrative Design for 400,000 Sq. Ft. School

This is a large school whose educational mission requires that equal space be programed for classroom and shop instruction. In a school of this size, compact three-story construction produces the most efficient administration and classroom buildings. The shop building is single-story, high-ceiling construction. The library is located near the administrative element with which it has the closest functional affinity. The support spaces are located at circulation nodes or along primary circulation routes. For utilities estimates see paragraph 6-7.

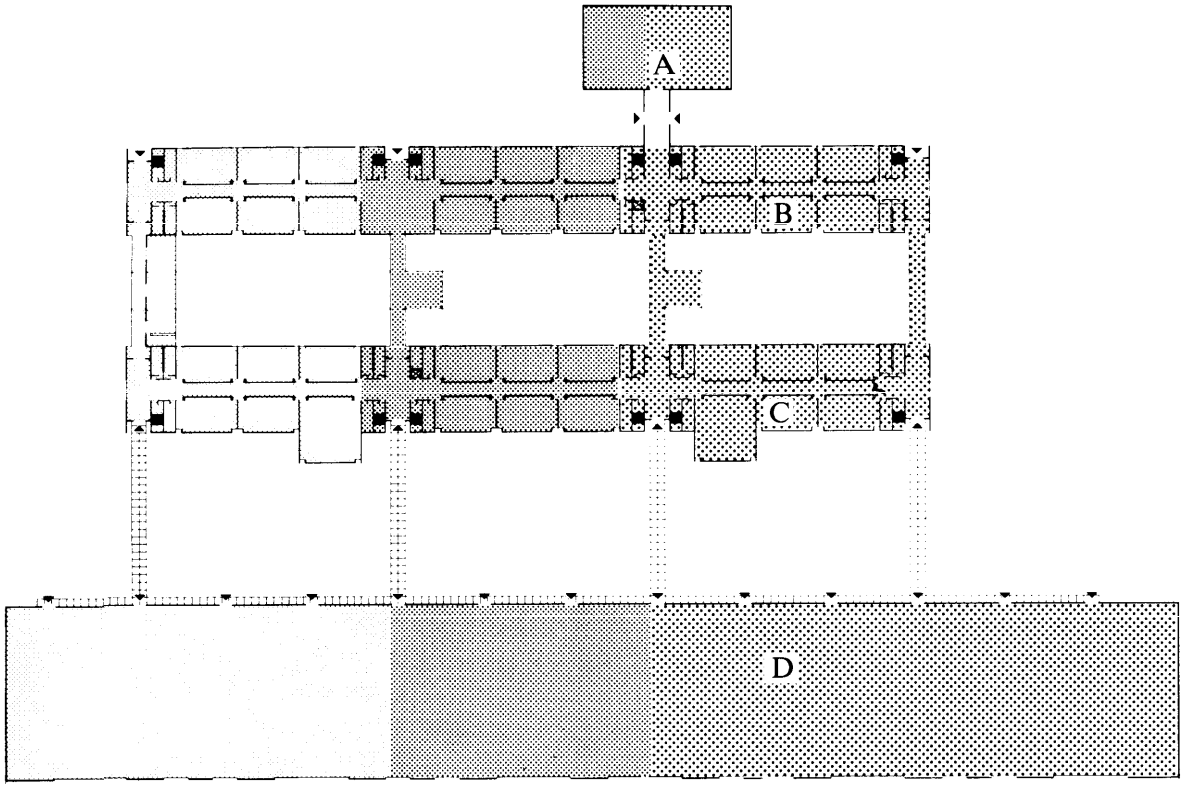


A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron
K Elevator

Description: Ratio of Classroom/Lab Space to Shop Space is 1:1. Administration — Three Stories. Classroom/Labs — Three Stories.

Utilities: Refer to Section 6-7.

Figure 6-4
Illustrative Plan, 400,000 Sq. Ft. School
(Equal Classroom and Shop Area).



A Technical Library
B Administration
C Classroom
D Applied Shop

Figure 6-5
Illustrative Plan, 400,000 Sq. Ft. School
(Three Phase Construction)

6-6 Analysis of Illustrative Designs

A. Function.

(1) Spaces are organized to group common functions. With the exception of the 30,000 sq. ft. school, each design zones major functional areas (i.e., administration, classroom instruction, shop instruction, and technical library) as separate elements. This allows different activities to operate independently while maintaining close proximity and increases the school's flexibility by allowing departments to share adjacent administrative and instructional spaces (see paragraph 5-2b(l) above). It also allows spaces to adapt quickly and easily to functional changes. For example, classrooms can be readily converted into labs or seminar rooms since all the necessary features (e.g., movable partitions and adaptable lighting controls) have been designed into the classroom building and since all the necessary instructional equipment and materials are consolidated there. These advantages also apply to the 30,000 sq. ft. school, since that design consolidates administrative and instructional spaces within a single building.

(2) Activity areas are spatially related according to their functional affinities (see paragraph 5-2a.). Classrooms are close to shops and to the administrative area. Since it is usually unnecessary for the administration area or the technical library to be close to the shop area, these two elements are located on one side of the school, and the shops on the other. In all cases, the technical library, because it is dedicated space and performs a unique and independent function, is separated from other functional elements.

(3) The spaces are organized to allow direct, efficient circulation with minimal disruption of intermediate areas. Common use facilities, restrooms, student lounges, snackbar, reception areas, are centrally located. In the case of the 30,000 sq. ft. school, these facilities are located near the center of the building; in the other schools, they are located at circulation nodes or along primary circulation routes. The shops are located along the periphery of the school so that vehicular traffic enters the shop area from one side pedestrian traffic from the other (see paragraph 2-4b(3)(c)). In all the designs which include a shop building, vehicular and pedestrian traffic is separated in this manner.

(4) Noise-generating activities are consolidated and separated from the other activities. Separating the shop building from the rest of the school and placing it along the school's periphery reduces the disruption caused by noise generated in shop areas. (See paragraph 5-2b(3)(a)).

(5) The structures are designed to accommodate the standard classroom module. The structural support frame is along the corridor and exterior wall line; the interior walls are non-loading-bearing. In addition, common framing dimensions are employed to the maximum extent possible. These two structural design principles allow for the rapid alteration of spatial configurations to meet changing functional requirements.

(6) Dedicated spaces are held to a minimum and planned so that they adjoin common use areas and other dedicated functions. For example, in Figures 6-3 and 6-4, the large, sloped-floor classrooms are located next to restrooms and major circulation nodes. This practice consolidates the school's dedicated space and permits multi-use spaces to be arranged in bands, rather than in isolated blocks; this, in turn, maximizes the flexibility of remaining spaces. For the same reason, when two or more sloped-floor classrooms are required, they are located along the same side of the corridor (see Figure 6-4).

B. Form.

(1) Spaces are organized in conjunction with planned sequences of viewing positions. All designs incorporate recessed entrances and exits and locate common-use elements at these points. Corridors are widened at circulation nodes and crossways are glazed to provide views of landscaping and vistas.

(2) Spaces are organized so as to result in compact facilities. For efficiency of circulation and conservation of heating and cooling energy, the form of the individual buildings and of the total facility has been designed to be as compact as possible, consistent with functional requirements. All schools have been designed with double-loaded corridors (i.e., activity areas on both sides of the corridor) so that total school circulation area is held to a minimum.

(3) All the schools illustrated in this chapter are designed within the maximum walking distances (see paragraph 5-2a(3)).

(4) Structures are planned for future expansion. As discussed in paragraph 2-4b(2)(i), the designer must plan for the future expansion of the service school. Figure 5-11 illustrates one way in which expansion planning can be accomplished. Based on estimates of the educational mission and student load at future points in time, the school is planned to expand in three phases. In each phase of construction, the existing facility maintains its functional organization and is not significantly affected by construction activities. For example, there is no overhead vertical expansion which could seriously impair instructional programs on lower floors. Furthermore, each phase is designed so that upon its completion the school can adapt to a new functional organization quickly and easily. This is accomplished by expanding each functional element along its periphery in such a way that the total facility maintains a compact form.

C. Economy.

(1) The designs conform to a 5 foot by 5 foot planning module. All the designs employ rectangular building forms, modular construction, and common framing dimensions, and thus are simple to construct. Because of this, they can readily make use of off-the-shelf building system components (see paragraph 5-3a(l)).

(2) The schools are designed to minimize operating costs. All schools are designed as compactly as possible and are oriented along a North-South axis. This practice minimizes consumption of heating and cooling energy. Multi-story construction is utilized in the larger

schools to achieve compactness, but all schools are limited in height to three stories or less so that stairs can be used as the primary mode of vertical circulation. Furthermore, the circulation grid in each school allows a section of the school to be set aside for multi-use occupancy during all school hours. Designated sections of the school can be opened for use and the required entrances and exits maintained, while the remainder of the school is secured. For example, in the 30,000 sq. ft. school, the half of the building on either side of the central entrance can be used; in the larger schools, any single section between circulation nodes can be opened during off school hours.

D. Time.

(1) Rapid Construction.
As discussed in paragraphs 3-2b and 3-2c, the illustrative designs employ simple rectangular spatial forms and common framing dimensions. This enhances the ease of construction and thereby reduces the amount of time required for construction.

(2) Planning for Expansion.
As discussed in paragraph 5-3c(2) the designer must plan for the future expansion of the service school. Figure 6-5 illustrates one way in which expansion planning can be accomplished. Based on estimates of the educational mission and student load at future points in time, the school is planned to expand in three phases. In each phase of construction, the existing facility maintains its functional organization and is not significantly affected by construction activities. For example, there is no overhead, vertical expansion which could seriously impair instructional programs on lower floors. Furthermore, each phase is designed so that upon its completion, the school can adapt to a new functional organization quickly and easily. This is accomplished by expanding each functional element along its periphery in such a way that the total facility maintains a compact form.

6-7 Utilities Requirements for Illustrative Designs

A. Mechanical Requirements.
The planning factors developed in this paragraph are based on paragraph 2-2h., General Planning Factors, and on the representative spatial organizations listed below. These planning factors are not for design of service school mechanical systems. Their function is to provide a quick estimate of mechanical requirements for initial planning and funding projections.

- A school of 30,000 sq. ft. (gross area) consisting entirely of classroom space and a small administration area.
- A school of 150,000 sq. ft. (gross area) consisting of shop and classroom instructional spaces in a 3 to 1 ratio and an administration area equal to 20% of the total school area.
- A school of 400,000 sq. ft. (gross area) consisting of equal areas of shop and classroom instructional spaces and an administration area equal to 25% of the total school area.

B. Electrical Systems.
Electrical system requirements will be based on the following:

(1) Lighting and Miscellaneous Power.

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	5	150
150,000 sq. ft.	5	750
400,000 sq. ft.	5	2,000

(2) Mechanical Power
(Heating and Ventilation Only).

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	2	60
150,000 sq. ft.	2	300
400,000 sq. ft.	2	800

(3) Mechanical Power
(Heating, Ventilation, and Cooling).

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	8	240
150,000 sq. ft.	8	1,200
400,000 sq. ft.	8	3,200

(4) Total Load Summary.

School	Total KVA Without A/C	Total KVA With A/C
30,000 sq. ft.	210	390
150,000 sq. ft.	1,050	1,950
400,000 sq. ft.	2,800	5,200

(5) Special Equipment.
Considerations for electrical systems include providing power for heavy shop equipment, computer equipment, and other special items with large electrical demands. Requirements of this kind must be identified by the using activity as required by TM 5-800-3, Project Development Brochures. Special electrical demands such as these have not been included in the electrical system requirements.

(1) Water.

Cold and hot water requirements will be based on the following:

a. Flow Rates.

School	Cold Water/ Person	Hot Water/ Person
30,000 sq. ft.	0.75 GPM	0.156 GPM
150,000 sq. ft.	0.40 GPM	0.10 GPM
400,000 sq. ft.	0.25 GPM	0.065 GPM

Note:

1. Heating period hours for all schools: 4.0
2. Peak load hours for all schools: 2.0

b. Total Water Consumption.

School	Cold Water Max. Flow	Cold Water Total/Day	Cooling Tower Make-up
30,000 sf	160 GPM	3,600 Gal	6 GPM
150,000 sf	300 GPM	11,250 Gal	10 GPM
400,000 sf	720 GPM	40,500 Gal	40 GPM

School	Hot Water Max. Flow	Hot Water Avg. Flow	Hot Water Total/Day
30,000 sf	30 GPM	25 GPM	750 Gal
150,000 sf	60 GPM	50 GPM	2340 Gal
400,000 sf	220 GPM	117 GPM	8425 Gal

(2) Sewage.

Flow rates will be based on the following:

School	Flow Rate	Total Flow/Day
30,000 sf	22.5 Gal/Day/Person	3,000 Gal
150,000 sf	22.5 Gal/Day/Person	11,250 Gal
400,000 sf	22.5 Gal/Day/Person	40,500 Gal

(3) Heating.

Requirements will be based on the following:

School	BTU/HR/SQ. FT.	Total MBH
30,000 sq. ft.	60	1,800
150,000 sq. ft.	50	7,500
400,000 sq. ft.	50	20,000

Note: Based on ambient temperature of 0 degrees F., D.B.

(4) Cooling.

Cooling requirements will be approximately 1 ton per 250 square feet (shop areas excluded):

School	Total Tons
30,000 sq. ft.	127
150,000 sq. ft.	325
400,000 sq. ft.	1,084

Note: Based on an ambient temperature of 95 degrees F., D.B. and 78 degrees F., W.B.